Removal of a bent tibial intramedullary nail: a rare case report and review of the literature

Sameer Aggerwal, Ashwani Soni, Uttam C. Saini and Nitesh Gahlot*

【**Abstract**】Intramedullary interlocking nailing is a gold standard for treatment of tibial shaft fractures. Bending of a nail secondary to trauma is a rare complication, which may be encountered in healed or unhealed tibial shaft fractures. Removal of such bent nail is always a challenge. We reported this case to discuss various techniques for removal of bent nails and to share our experience in removing a bent tibial intramedullary nail in a 30-year-old man, who was admitted in our department with re-fracture of the right tibial shaft due to a roadside accident two years after the initial surgical treatment. The intramedullary nail, bent by 30 degrees and visible on anterioposterior as well as on lateral radiographs, was firstly weakened by partially cutting the convex wall, then straightened by applying external force, and finally removed by using the standard nail removal method.

Key words: ***Fracture fixation, intramedullary; Tibial fractures; Device removal***

Chin J Traumatol 2011; 14(2):107-110

Intramedullary nailing is a gold standard treatment for adult comminuted diaphyseal fractures of the tibia in present era.[1] The union rate has been reported up to 100% in most series. Elective removal of the standard intramedullary nail can be a major procedure in long bone fractures because of implant deformation and on-growth of new bone. Excessive deformation and stress in vivo may cause break of the implant, which may be visible or invisible on X-ray films. An intact or deformed screw may break under even small shear or torque applied in the attempt of removal.[2] Once it breaks, removal will become very difficult.

There are several methods reported for removal of bent intramedullary nails.[2-11] Most of these cases are related to femoral nail, and after thorough review of the literature, we only came across two studies regarding bent tibial nails.[8,11] Furthermore, we did not find any case of bent tibial nail removal by partially correcting the deformity after partially cutting the nail. We are reporting for the first time a case of bent tibial nail that was partially cut with drill on the convex surface of deformity, partially corrected by applying force and then removed by standard extraction technique.

DOI: 10.3760/cma.j.issn.1008-1275.2011.02.009

Department of Orthopaedics, Post Graduate Institute of Medical Education & Research, Chandigarh 160012, India (Aggerwal S, Soni A, Saini UC and Gahlot N)

*Corresponding author: Tel: 91-9855004450, Email: dr_uttamsaini@yahoo.co.in

CASE REPORT

A 30-year-old male presented at our institute with two days' history of roadside accident. On examination he had deformity over the right leg with a wound about 15 cm×5 cm from the posteromedial aspect (Figure 1). There was no abnormal mobility of the leg and neurovascular status was intact. The patient had a history of right tibia fracture 2 years ago due to roadside accident when intramedullary interlocking nailing was done. Postoperative period at that time was uneventful and he started full weight bearing 3 weeks later as advised by the previous surgeon.

Fresh X-rays were taken, which showed fracture of the tibial shaft with both posterior and medial angulation and bent nail in situ, un-displaced fracture of the medial condyle of tibia, and bimalleolar fracture at ankle. The fibula was intact with no signs of old fractured fibula at the time of previous injury (Figures 2 and 3).

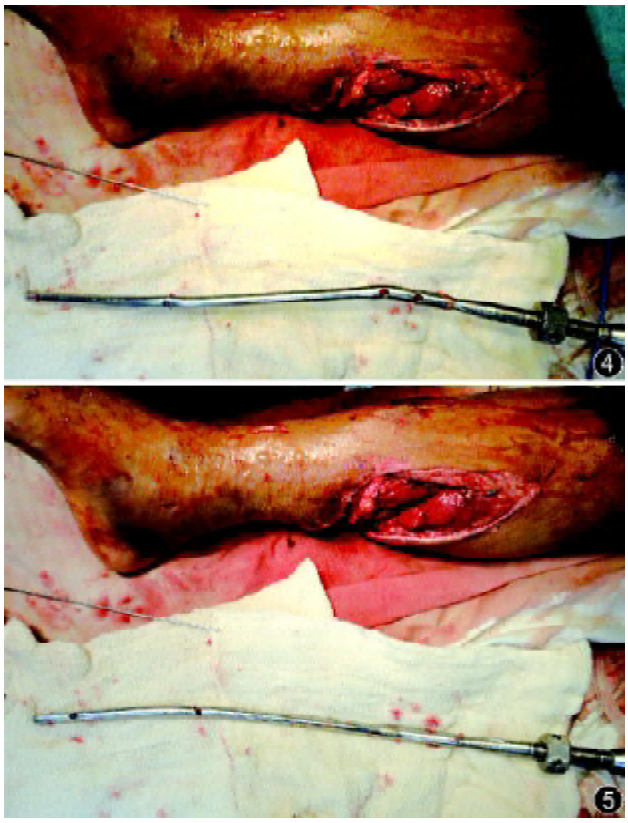
The patient was taken up for surgery. Wound was debrided. Attempt was made to remove the nail by standard technique, as described by Yip et al[11], but not succeeded. Correction of deformity as described by Patterson and Ramser[12] for bent femoral nail was thereafter tried but also failed. We gave an incision over the convex side of the deformity and exposed the fracture

Chinese Journal of Traumatology 2011; 14(2):107-110

site. Due to posteromedial angulation, the anterolateral part of the fractured tibia was opened up and nail was exposed at that site. We tried to cut the nail with a metal cutting saw but it caused injury to the surrounding soft tissues. Therefore, we made a window on the anterolateral aspect of the nail with the help of metal cutting drill (Figure 4). Continuous saline irrigation was used to wash out the debris of the nail and keep the site cool to prevent thermal injury. Gauge pieces were placed to prevent contaminating surrounded tissues with metal debris. The posteromedial aspect of nail was intact. After then, nail became weak and deformity was partially corrected by applying force, and finally removed by standard technique (Figure 5). External fixator was applied. Tibial condyle was fixed with partially threaded cancellous screws, tension band wiring was done for medial malleolus fracture, and fibula was fixed with K-wires.

Figure 1. Deformed leg with open wound in posteromedial aspect.

Figures 2 and 3. AP and lateral radiographs showing bent tibial nail with fracture of the shaft and both lateral and medial malleolus.



Figures 4 and 5. Clinical photographs showing a nail that was partially cut, partially corrected and removed by extraction devices.

DISCUSSION

Breakage of the intramedullary nails mostly occurs in nonunion, comminuted or unstable fractures, or fixation of osteotomies and pathological fractures because of metal fatigue and/or thin nails.[5] Bending of nails is common in secondary traumas and removal of these bent nails is more difficult than that of broken nails. Bending is usually seen late after fracture healing. One reason for this may be that it is uncommon for patients with recently nailed fractures of long bone to sustain another high-energy injury to the same extremity because the original injury usually prevents them from engaging in such activity.

Jones and Schmeling[13] reported a case of tibial fracture during removal of a tibial intramedullary nail. Kelsch et al[8] failed to remove a bent unreamed tibia nail (UTN) and concluded in their study that it is very difficult to remove a bent UTN and it could only be removed by causing additional damage to the tibia. They suggested that prevention is better and advised modification of the arrangement of the locking holes in UTN, which can minimize the probability of the occurrence of bent nail.

We cannot leave the already bent nail in situ, which needs to be removed because of many reasons, e.g. firstly the tibia will heal and take the shape of the bent nail; secondly the nail is likely to become weaker and weaker as a result of the angulation and may break in future. Removal should be done as early as possible, better before the fracture heals. After healing of the fracture, nail removal would be more difficult in such cases.[11]

Most articles dealing with problems of intramedullary nail removal have focused on how to manage the fractured implant that remains buried inside the medullary canal.[14-20] This usually involves the insertion of long hooks, special extraction devices[21], or smaller diameter nails down the intramedullary canal[22]. Small percutaneous osteotomes are sometimes needed.[14]

A variety of different techniques have been proposed for the removal of a bent nail.[2-8,10,23,24] Some of them cut the nail totally from where it bent and then remove it.[25-28] Some authors suggested first weakening the nail at the existing site with metal drills or diamond cutters and then correcting and removing. This may be performed after exposing the fracture site,[2,4,5,29] or by percutaneous method[3]. Some advised correcting the nail in situ and then removing without exposing the fracture site.[4] But none of the cases were about bent tibial nails.

Yip et al[11] reported two cases on bent tibial nails, which were removed by standard technique. In their first case, the angulation of deformity was 26° posterior and 30° valgus, while in the second case it was 13° anterior and 20° valgus.

It is not always easy to remove the bent nail by standard technique. The removal procedure also depends upon the angulation of deformity of the nail, as well as stiffness of the nail. When a bent nail is pulled out of the canal it changes shape according to the canal. This change of shape is inversely proportional to the stiffness of the nail. The severer the deformity is, the more difficult the removal will be. Similarly a stiffer nail is more difficult to remove. In our case it was a stainless steel nail which was stiffer than titanium nail and moreover there was a large deformity of 30° in both AP and lateral views of X-rays. We tried to correct deformity by applying force but failed. We also tried removal by standard technique as done by Yip et al[11] but the nail was stiff and not pulled out. In the end we weakened the nail by partly cutting it with a drill and then correcting the deformity. It is easy to remove nail after partially cutting the convex side of bent nail and correcting its bend to make it straight then to cut it into two pieces and remove these two pieces. We found that cutting with a metal cutting drill is better than with a saw as a saw causes more soft tissue injury. Then we removed the nail by standard technique. Full correction of deformity is not necessary because the rest of the deformity will correct itself due to the deformation property of the nail as it passes through medullary canal. This method does not depend on special surgical instruments and can be performed in any operating room.

In conclusion, bent tibial nails should always be removed. But the removal process can be much easier after partial cut of the nail on the convex side by using a metal cutting drill bit, followed by partial correction of the deformity. This technique can be used to remove severely angulated and stiff nails after manual correction in situ and standard nail removal techniques fail. It is quite safe and has advantages in terms of chances of secondary fracture, injuries to surrounding soft tissues and surgical time. Moreover, this method does not require any special instruments and can be used anywhere in similar cases.

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(Received October 28, 2010)
Edited by LIU Gui-e